rized during school years, the interdisciplinary and somewhat data-deficit domain of astrobiology might lie in the precise intellectual space to positively influence these debates about the most appropriate role of science in public policy, technological innovation, societal worldviews, and education of our youth. If microbiologists and paleontologists have been unsuccessful at convincing the US public that biological evolution exists and that astrophysicists have similarly been unsuccessful at arguing for an astronomical "Big Bang" evolution, perhaps astrobiologists working in the extreme environments of Earth and beyond have an advantage for helping the public value the nature of science and its interrelationships with technology and society.

O-60. Compositional Constraints for Bioastronomy from the Deep Impact Mission to Comet 9P/Tempel 1

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The Deep Impact (DI) mission provided our first compositional information on a spatially resolved cometary nucleus and the upper tens of meters of the interior of comet Tempel 1. We report on the compositional finding from the DI spacecraft instruments. Based on absorptions in IR spectra, water ice was found to exist only in isolated areas on the surface of Tempel 1. Water ice is also found to be present at all depths from ~1 to ~10 m within the cometary interior. Furthermore, the structure of the water ice does not change with depth and is fine-grained (~1 μm) and pure. These observations are difficult to rectify with specifics of the Greenberg model of "silicates core-organics refractory mantle" cometary particles and suggest alternative formation models are required. The timing and spatial distribution of the water ice in the DI ejecta also indicate that the upper ~1 m of Tempel 1 has been devolatilized. This result is consistent with the annual thermal wave propagation depth inferred from DI measurements of surface temperature. While the DI ejecta reveal the internal composition of the impact site, there is also significant evidence from DI measurements that Tempel 1 is heterogeneous. For example, DI analyses reveal a complicated surface morphology, evidence of layering, and uncorrelated distributions of H_2O and CO_2 vapor in the ambient coma.

O-61. The Allen Telescope Array for SETI and Radio Astronomy

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The first 42 antennas of the Allen Telescope Array (ATA-42) are beginning to collect data at the Hat Creek Radio Observatory in Northern California. The array is being built and operated as a partnership between the SETI Institute and the Radio Astronomy Lab at UC Berkeley. The ATA will eventually include 350 antennas and is the first radio telescope designed to enable traditional radio astronomy and SETI observations simultaneously in a multiple-concurrent mode of operation. The ATA collecting area and sensitivity will be equivalent to a 114 m telescope (the ATA-42 has a 40 m equivalent diameter). Because the array is composed of small antennas, that will be spread as far apart as 900 m, it will observe a very large field of view (3.5° FWHM at 1 GHz) and achieve excellent spatial resolution (~100 arc seconds at 1 GHz). The receiver system for the array provides continuous frequency coverage from 0.5 to 11 GHz; four separate frequency bands of 100 MHz bandwidth can be observed simultaneously. Electronics enable the formation of four dual-polarization phased array beams at each frequency (32 beams total), and two spectral-imaging correlators can be used to make maps of the entire field of view at two frequencies. This paper describes the ATA and how it will be used as a wideangle, polychromatic radio-camera for astronomy surveys and for SETI, starting with a search of 20 square degrees of the galactic plane over the entire "water hole" from 1420 to 1720 MHz.

O-62. Spectral Signatures from Super-Earths, Warm and Hot-Neptunes

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ESA's and NASA's planet characterization missions will allow us to explore the diversity of planets around stars of different spectral type and will expand the existing field of comparative planetology beyond our Solar System. In particular, terrestrial planets greater than one Earth-mass are not represented in our Solar System, but may occur in others (Beaulieu *et al.*, 2006; Rivera *et al.*, 2005). The next generation of space telescopes, the James Webb Space Telescope (2013), will have the capability of acquiring transmission and emission spectra in the infrared of these extrasolar worlds. Further into the future, the direct imaging of exoplanets, both in the optical and infrared, will extend our understanding to extrasolar bodies orbiting few Astronomical Units from their parent star and expand our knowledge to smaller-size objects.

For the first time, the mission CNES/ESA-CoRoT will detect transiting sub-giant planets, *i.e.* Super-Earths and Neptunes. Knowing the planetary radius and mass, we can infer the average planetary density. This information will be crucial to understand their internal composition (Sotin *et al.*, 2007; Fortney *et al.*, 2007; Kuchner and Seager, 2006). Hot-Neptunes might be the evaporation remnants of migrated giants. Super-Earths might be either the evaporation remnants of migrated Neptunes or just massive terrestrial planets. In these two cases the atmospheres should be quite different. We explored this grey zone between terrestrial and giants, both from the theoretical and observational point of view, focusing on atmospheric chemistry, spectral signatures, and detectability of atmospheric features.

O-63. The Habitable Zone Revisited

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The current state-of-the-art calculation of the Habitable Zone (HZ), given in a classic 1993 paper by Kasting *et al.*, is based on physical approximations which were entirely adequate to define the HZ for applications relevant at the time. However, now that performance specifications for the design of multi-billion-dollar space missions (such as the *Terrestrial Planet Finder, TPF*, and *Darwin*) are driven by the science requirement of searching the HZ, it is appropriate to carry out more realistic and detailed calculations in order to achieve a more sophisticated and accurate HZ definition. Effects not included in the conventional HZ calculations include dissolved impurities (*e.g.*, salts) in a planet's oceans, atmospheric surface pressures other than 1 bar (due to varying planetary mass and atmospheric mass), variable illumination with position on the planetary surface, diurnal cycles, topographic relief (and the resulting pressure variation), heat transport by atmospheric and oceanic circulation, atmospheric composition, and internal planetary heat sources. In addition to implications for the design of missions such as *TPF* and *Darwin* as well as for interpretation of results from the *Kepler* and *Corot* missions, a better understanding of the HZ bears directly on the likely prevalence and distribution of life in the Universe. This paper presents an initial assessment of the size and sign of the HZ modifications produced by inclusion of the effects listed above.

O-64. A Sensitive Search for Life Signatures in the Martian Atmosphere

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The recent claims by three teams of the existence of methane (CH_4) on Mars imply the possibility of life beyond Earth. This possibility is strengthened by the presence of vigorous biocommunities (including methanogens and methanotrophs) found in terrestrial analogue sites such as sub-permafrost zones. Conducting searches for biomarker gases is particularly convenient at infrared wavelengths owing specifically to rovibrational C-H stretching modes in hydrocarbons, which fall in the range ~3.2–3.6 μm. More generally, in the 2–5 μm spectral region, many molecules of possible biological and geothermal origin have strong signatures, for example H_2O, HDO, CO_2, CH_4, C_2H_6, H_2CO, CH_3OH, C_2H_2, SO_2, OCS, N_2O, NH_3, HCN and CH_3Cl.

We have investigated, both theoretically and by means of high-resolution spectroscopic observations, this rich spectral region on Mars. Increasingly sensitive studies of planetary atmospheres have become possible thanks to recent (and ongoing) technological developments in ground-based infrared instrumentation. However, the sensitivity of the retrievals is strongly constrained by how precisely the telluric spectral signatures are removed from the raw data. For that purpose, we have recently developed new algorithms to process the data and have integrated highly sophisticated atmospheric models for the synthesis of Martian and terrestrial spectra (CODAT & GENLN2). This has led to significantly more robust retrievals of spectral signatures of Mars.

In this talk, we present the most extensive and comprehensive search for biomarkers on Mars, which includes over 10 years of mapping the spatial distribution of the different biomarker gases over different Mars seasons and local conditions.

O-65. DAZd White Dwarfs and the Fate of Planetary Systems

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I will present Spitzer and ground-based observation of five metal-polluted white dwarfs with circumstellar debris disks (DAZd). Four of these objects are newly discovered. For two of the white dwarfs, I will present Spitzer 5.5–14 micron spectroscopy, highlighting the 9–11 micron emission feature caused by mixture of amorphous olivine and forsterite. The emitting region is located 0.1–5 R_{sun} from the WDs. Our measurements support the idea that disruptions of comets or asteroids created the debris disks. Based on the properties of these five stars, I interpret the bulk of the metal-polluted white dwarfs as resulting from planetary system bodies being ground down during the late stages of stellar evolution. If correct, this implies that $\geq$25% of all stars are orbited by terrestrial-type planets, asteroids, or comets.

O-66. The Evolutionary Position of the Unique, Tropical Placozoa in the Animal Tree of Life

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